

WHAT IS CLAIMED IS:

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1. An image processing apparatus comprising:
    - labeling means for extracting frame image data from moving image data, segmenting the frame image data into blocks, and assigning labels in accordance with feature amounts obtained in units of blocks;
    - sequential label set generation means for generating a sequential label set by arranging the labels assigned by said labeling means in a predetermined block order;
    - sequential label set accumulation means for accumulating the sequential label set generated by said sequential label set generation means in connection with the frame image data;
    - similarity computation means for computing similarities between the generated sequential label set and sequential label sets of a previous frame image data group;
    - scene change detection means for detecting a scene change frame in the moving image from a group of computed similarities; and
    - scene change storage means for storing information of the detected scene change frame in connection with the frame image data.
  2. The apparatus according to claim 1, wherein the information of the detected scene change frame includes

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the number of frames or an elapsed time from the beginning of the moving image to the detected scene change frame.

3. The apparatus according to claim 1, wherein the  
5 labels are unique labels which are given to individual cells obtained by segmenting a multi-dimensional feature amount space into a plurality of cells, and said labeling means computes a feature amount for each block, and assigns to that block a label given to the  
10 cell to which the computed feature amount belongs.

4. The apparatus according to claim 3, wherein the moving image is a color image, the feature amount corresponds to a position of a color element value in the multi-dimensional feature amount space, and the  
15 labels are unique labels given to individual cells obtained by segmenting the multi-dimensional feature amount space into a plurality of cells.

5. The apparatus according to claim 1, wherein the plurality of blocks are obtained by segmenting an image  
20 into a plurality of vertical and horizontal blocks, and the block order used in said sequential label set generation means is an order in which the plurality of blocks are scanned in a horizontal or vertical direction.

25 6. The apparatus according to claim 1, wherein said scene change detection means comprises determination

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means for determining a scene change when the similarity computed by said similarity computation means is not more than a predetermined value.

7. The apparatus according to claim 1, wherein said  
5 similarity computation means has a penalty table for holding penalty vales in correspondence with pairs of label values, acquires penalty values by referring to said penalty table using pairs of label values obtained from a sequential label set of the frame image data of  
10 a scene change frame candidate and sequential label sets of the previous frame image data group, and computes the similarity on the basis of the acquired penalty values.

8. The apparatus according to claim 7, wherein the  
15 labels are unique labels which are given to individual cells obtained by segmenting a multi-dimensional feature amount space into a plurality of cells, and the penalty value is a value set based on a distance between cells expressed by two labels.

9. The apparatus according to claim 7, wherein said  
20 similarity computation means also gives penalty values representing degrees of similarity of the labels upon computing the similarity between the sequential label set of the frame image data of the scene change frame  
25 candidate and the sequential label sets of the previous frame image data group.

10. The apparatus according to claim 7, wherein said similarity computation means computes the similarities by DP matching using the penalty values.

11. The apparatus according to claim 10, wherein said  
5 similarity computation means further comprises setting  
means for setting a width of a matching window of DP  
matching to be used.

12. The apparatus according to claim 1, wherein the sequential label set represents a two-dimensional label matrix set, and

said similarity computation means comprises:

first matching means for corresponding sequential label sets in units of lines extracted from a label matrix of frame image data of a scene change frame candidate, and sequential label sets in units of lines extracted from a label matrix of previous frame image data by DP matching to obtain a line arrangement of the extracted the extracted image data; and

second matching means for obtaining similarity  
20 between a line arrangement of the label matrix of the  
frame image data of the scene change frame candidate,  
and the line arrangement obtained by said first  
matching means by DP matching.

13. The apparatus according to claim 12, wherein the  
25 sequential label sets in units of lines are each an

arrangement corresponding to a horizontal direction of an image.

14. The apparatus according to claim 12, wherein the sequential label sets in units of lines is an arrangement corresponding to a vertical direction of an image.

15. The apparatus according to claim 12, further comprising frame determination means for determining the frame image data of the scene change frame candidate to be scene change frame image data, when the similarity obtained by said second matching means becomes not more than a predetermined value, and similarities obtained by said second matching means as a result of the same processes for previous frame images become not more than the predetermined value.

16. The apparatus according to claim 12, wherein said first matching means has a penalty table for holding penalty values in correspondence with pairs of labels, and refers to said penalty table upon computing a distance between a sequential label set of the frame image data of the scene change frame candidate and the sequential label set of the previous frame image data using DP matching.

17. The apparatus according to claim 12, wherein said  
25 second matching means has an inter-line penalty table  
for holding penalty values in correspondence with pairs

of line numbers in the line arrangement, and refers to the inter-line penalty table upon computing similarity between the line arrangement of the frame image data of the scene change frame candidate and the line arrangement of the previous frame image using DP matching.

18. The apparatus according to claim 17, further comprising penalty holding means for determining penalty values corresponding to pairs of lines on the basis of similarities of sequential label sets of the frame image data of the scene change frame candidate in the line direction, and holding the determined penalty values as the inter-line penalty table.

19. The apparatus according to claim 14, wherein said  
15 first matching means gives a penalty and constraint  
upon scaling a sequential label set to be compared when  
similarity between a label sequence of source image  
data and a sequential label set stored in said storage  
means is computed.

20 20. The apparatus according to claim 19, wherein the  
penalty and constraint upon scaling the sequential  
label set to be compared are acquired on the basis of a  
theory of DP matching.

21. The apparatus according to claim 12, further  
25 comprising first matching window setting means for

setting a width of a matching window of DP matching  
used by said first matching means.

22. The apparatus according to claim 12, further comprising second matching window setting means for setting a width of a matching window of DP matching used by said second matching means.

23. A scene change detection method comprising the steps of:

extracting frame image data from moving image  
10 data, segmenting the frame image data into blocks, and  
assigning labels in accordance with feature amounts  
obtained in units of blocks;

generating a sequential label set by arranging the assigned labels in a predetermined block order;

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15         computing similarities between the generated
        sequential label set and sequential label sets of a
        previous frame image data group; and

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detecting a scene change frame in the moving image from a group of computed similarities.

20 24. The method according to claim 23, wherein  
information of the detected scene change frame includes  
the number of frames or an elapsed time from the  
beginning of the moving image to the detected scene  
change frame.

25    25.    The method according to claim 23, wherein the  
labels are unique labels which are given to individual

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cells obtained by segmenting a multi-dimensional feature amount space into a plurality of cells, and the step of assigning the labels includes the step of computing a feature amount for each block, and

5 assigning to that block a label given to the cell to which the computed feature amount belongs.

26. The method according to claim 25, wherein the moving image is a color image, the feature amount corresponds to a position of a color element value in  
10 the multi-dimensional feature amount space, and the labels are unique labels given to cells obtained by segmenting the multi-dimensional feature amount space into a plurality of cells.

27. The method according to claim 23, wherein the  
15 plurality of blocks are obtained by segmenting an image into a plurality of vertical and horizontal blocks, and the block order used in the step of generating the sequential label set is an order in which the plurality of blocks are scanned in a horizontal or vertical  
20 direction.

28. The method according to claim 23, wherein the step of detecting a scene change includes the step of determining a scene change when the similarity computed in the step of computing similarities is not more than  
25 a predetermined value.



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29. The method according to claim 23, wherein the step of computing similarities uses a penalty table for holding penalty vales in correspondence with pairs of label values, and includes the step of acquiring  
5 penalty values by referring to the penalty table using pairs of label values obtained from a label sequence of the frame image data of a scene change frame candidate and label sequences of the previous frame image data group, and computing the similarities on the basis of  
10 the acquired penalty values.

30. The method according to claim 29, wherein the labels are unique labels which are given to individual cells obtained by segmenting a multi-dimensional feature amount space into a plurality of cells, and the  
15 penalty value is a value set based on a distance between cells expressed by two labels.

31. The method according to claim 29, wherein the step of computing similarities includes the step of also giving penalty values representing degrees of  
20 similarity of labels upon computing the similarity between the sequential label set of the frame image data of the scene change frame candidate and the label sequence of the previous frame image data.

32. The method according to claim 29, wherein the  
25 step of computing similarities includes the step of

computing the similarities by DP matching using the penalty values.

33. The method according to claim 32, wherein the step of computing similarities includes the step of  
5 setting a width of a matching window of DP matching to be used.

34. The method according to claim 23, wherein the sequential label set represents a two-dimensional label matrix, and

10 the step of computing similarities includes:

the first matching step of corresponding sequential label sets in units of lines extracted from a label matrix of frame image data of a scene change frame candidate, and sequential label sets in units of  
15 lines extracted from a label matrix of previous frame image data by DP matching to obtain a line arrangement of the extracted the extracted image data; and

the second matching step of obtaining similarity between a line arrangement of the label matrix of the  
20 frame image data of the scene change frame candidate, and the obtained line arrangement by DP matching.

35. The method according to claim 34, wherein the sequential label sets in units of lines are each an arrangement corresponding to a horizontal direction of  
25 an image.

36. The method according to claim 34, wherein the sequential label sets in units of lines are each an arrangement corresponding to a vertical direction of an image.

5 37. The method according to claim 34, wherein the frame image data of the scene change frame candidate is determined to be scene change frame image data, when the similarity obtained in the second matching step becomes not more than a predetermined value, and  
10 similarities obtained in the second matching step as a result of the same processes for previous frame images become not more than the predetermined value.

38. The method according to claim 34, wherein the first matching step uses a penalty table for holding  
15 penalty values in correspondence with pairs of labels, and includes the step of referring to the penalty table upon computing a distance between a sequential label set of the frame image data of the scene change frame candidate and the sequential label set of the previous  
20 frame image data using DP matching.

39. The method according to claim 34, wherein the second matching step uses an inter-line penalty table for holding penalty values in correspondence with pairs of line numbers in the line arrangement, and includes  
25 the step of referring to the inter-line penalty table upon computing similarity between the line arrangement

of the frame image data of the scene change frame candidate and the line arrangement of the previous frame image using DP matching.

40. The method according to claim 39, wherein penalty  
5 values corresponding to pairs of lines are determined  
on the basis of similarities of sequential label sets  
of the frame image data of the scene change frame  
candidate in the line direction, and the determined  
penalty values are held as the inter-line penalty table.

41. The method according to claim 36, wherein the first matching step includes the step of giving a penalty and constraint upon scaling a sequential label set to be compared when similarity between a sequential label set of source image data and a sequential label set stored in storage means is computed.

42. The method according to claim 41, wherein the penalty and constraint upon scaling the sequential label set to be compared are acquired on the basis of a theory of DP matching.

20 43. The method according to claim 34, wherein a width  
of a matching window of DP matching used in the first  
matching step is set.

44. The method according to claim 34, wherein a width  
of a matching window of DP matching used in the second  
25 matching step is set.

45. A storage medium for storing a control program for making a computer execute scene change detection, said control program including:

the step of extracting frame image data from  
5 moving image data, segmenting the frame image data into blocks, and assigning labels in accordance with feature amounts acquired in units of blocks;

the step of generating a sequential label set by  
arranging the assigned labels in a predetermined block  
10 order;

the step of computing similarities between the generated sequential label set and sequential label sets of a previous frame image data group; and

the step of detecting a scene change frame in the  
15 moving image from a computed similarity group.

46. The medium according to claim 45, wherein the labels are unique labels which are given to individual cells obtained by segmenting a multi-dimensional feature amount space into a plurality of cells, and the  
20 step of assigning the labels includes the step of computing a feature amount for each block, and assigning to that block a label given to the cell to which the computed feature amount belongs.

47. The medium according to claim 45, wherein the  
25 step of computing similarities includes the step of

computing the similarities by DP matching using penalty values.

48. The medium according to claim 45, wherein the sequential label set represents a two-dimensional label matrix, and

the step of computing similarities includes:

the first matching step of corresponding sequential label sets in units of lines extracted from a label matrix of frame image data of a scene change frame candidate, and sequential label sets in units of lines extracted from a label matrix of previous frame image data by DP matching to obtain a line arrangement of the extracted the extracted image data; and

the second matching step of obtaining a similarity between a line arrangement of the label matrix of the frame image data of the scene change frame candidate, and the obtained line arrangement by DP matching.

49. The medium according to claim 48, wherein the  
20 frame image data of the scene change frame candidate is  
determined to be scene change frame image data, when  
the similarity obtained in the second matching step  
becomes not more than a predetermined value, and  
similarities obtained in the second matching step as a  
25 result of the same processes for previous frame images  
become not more than the predetermined value.



53. The medium according to claim 48, wherein the first matching step includes the step of giving a penalty and constraint upon scaling a sequential label set to be compared when similarity between a label sequence of source image data and a sequential label set stored in storage means is computed.

54. The medium according to claim 48, wherein the first matching step and/or the second matching step include/includes the step of setting a width of a matching window of DP matching used.

55. The apparatus according to claim 11, wherein when the apparatus is equipped in a movie, the width of a matching window is changed in accordance with a mount of shaking detected by a sensor.

15 56. The method according to claim 33, wherein in a movie, the width of a matching window is changed in accordance with a mount of shaking detected by a sensor.

57. The medium according to claim 45 wherein in a movie, the width of a matching window is changed in accordance with a mount of shaking detected by a sensor.